In this vicinity there was practically no scarcity of water for either live stock or domestic purposes, as artesian wells are numerous and in many cases tend to feed small watercourses, and other wells are generally deep. The streams are low.

During the heat wave dry weather predominated, except that a generous rain fell on August 17. On September 7 more seasonable temperature set in and continued until this writing, September 15. By this date small grains were mostly in the bin or granary, and corn and other late crops were practically all either matured or nearly so, except late vine crops.

The temperature conditions during the heat wave, while causing considerable discomfort, resulted in no material increase in mortality in either human or animal life, so far as appears. During the heated period in September there was no decidedly great discomfort if one was in a breeze, the heat being dry, and the nights, comparatively cool, gave relief.

FOR THE STATE.

The conditions for the State as a whole were similar to the local conditions, except that the southeastern and extreme eastern counties were favored with more rain. Most of the northern and western counties were more affected by dry weather than other parts. In the western counties, excepting the Black Hills, there is nearly always warmer weather than elsewhere in the State.

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## DROUGHT AND HEAT WAVE OF THE SUMMER OF 1913 IN KENTUCKY.

By FERDINAND J. WALZ, Professor of Meteorology.

The shortage in rainfall together with the intense heat which prevailed so largely during the summer and crop-growing months of 1913 resulted in one of the most severe, far-reaching, and destructive droughts experienced in this section during the past quarter of a century. In heat the season is comparable only to that of 1901, and in dryness to the seasons of 1894 and 1904. In the combination of both heat and dryness for so long a time the season of 1913 has no equal in the records of the past 25 years.

Deficiency in rainfall began with the month of April and continued through the months of May, June, July, and August, and the first decade of September. The average aggregate rainfall for the months April to August, inclusive, for the State of Kentucky as a whole was 13.87 inches, or a deficiency of nearly 5.50 inches. The year having the next smallest amount for these months is 1894, with 14.8 inches. In 1904 the amount was 15.06 inches. In 1901 rainfall was deficient up to the month of August, the driest month being July, which is also the hottest month of record in this section, but in August of that year there was ample rainfall over the greater portion of the State, the droughty conditions continuing only in the north border counties. In 1895 rainfall was decidedly deficient during the crop-growing months except July, when generous rains occurred which not only terminated the drought but gave a sufficient excess of moisture to tide over the deficiency of August and September. In 1889, another dry year, the rainfall was plentiful in May, June, and July, the dry months occurring in the early part of the year and after July.

The drought of the current year was most severe in the western part of the State, where in many of the counties the total rainfall for the five months ranged between 7 and 12 inches, a deficiency of 9 to 13 inches. The drought was felt least in the central portion of the State and over sections on the western border of the mountain region, the rainfall in these sections ranging between 11 and 20 inches, a deficiency of 1 to 7 inches. At Middlesboro, in the extreme southeastern part of the State, the rainfall of this period was 12.4 inches, which shows a deficiency of 10 inches, but the normal in that section is large.

At Louisville, Ky., from April 1 to September 10, 1913, the total rainfall was 11.4 inches, or 8.6 inches below the normal for that period. The driest year, however, at Louisville since the records began in 1871 was 1904. From April 1 to September 10, inclusive, of that year the total rainfall was 10.7 inches, and the deficiency was much greater in October and November, the total rainfall for these two months being only 0.52 inch. Other dry years were: 1881 with a rainfall of 11.92 inches; 1894, 17.85 inches; and 1901, 15.0 inches in the period under discussion. In 1881 only 0.15 inch fell during the month of August.

The intense heat began the 16th of June and continued with few interruptions until September 8. The longest interruption in this heat wave was from July 19 to 26, inclusive. During these 12 weeks the temperature was above normal at Louisville and Lexington on 63 days. The temperature was 90° or above at Lexington on 40, and at Louisville on 55 of these days, and it was 100° or above at Louisville on 5 days.

In 1894 and 1901 the temperature was 90° or above at Louisville on 52 and 48 days, respectively, for a like period. At Louisville the temperature was above normal on 66 days in 1901 and on 41 days in 1904. In 1901 the temperature was 90° or above on 48 days and 100° or above on 7 days at Louisville, and the average maximum temperature for the month of July was 95.2. In 1904 the temperature did not reach 100° and was 90° or above on only 24 days.

Considering the State as a whole and the duration, the hot wave of this year exceeds that of any year on record. The hot weather of 1901 occurred mostly in the month of July, while this year it extended through practically 12 weeks.

The following statements relative to the effect of the drought and hot weather upon crops, water supply, etc., are gathered from the September crop report of the commissioner of agriculture for the State of Kentucky, from personal correspondence with him, interviews with persons who have been over the State, newspaper reports, and general hearsay. In the main, reports from all these sources agree that all crops, except wheat, oats, and early hay suffered severely from heat and lack of moisture, yet the reports as to the extent of the damage vary so considerably that anything like a true estimate at present of the amount of damage inflicted on the several crops is impossible.

The wheat, which is harvested in the latter part of June or the first part of July, was a very good crop and of unusually good quality, the weather being ideal at time of harvest. The oats crop was also good. Corn and tobacco will hardly make an average half crop, and abundant rains now, September 13, would not help these crops, as they are, for the most part, in the curing period,

their condition being much advanced by the hot, dry weather. The early hay crop was good, but there has been practically no late crop of hay. Alfalfa is about one-half crop, cow peas and soy beans about two-thirds of a crop, and spring-sown clover and bluegrass about 60 per cent of a crop. Pastures were completely burned up, and live stock suffered materially on account of short pastures and scarcity of water. The fruit crop was small and gardens were practically a failure, there being hardly any tomatoes, beans, peas, or sweet corn. The onion crop is unusually short and potatoes are practically a failure. A farmer who has 8 acres in late potatoes in the vicinity of Louisville, and who follows the most modern methods of farming, states that he has hardly a potato in his entire 8 acres. There were practically no early potatoes, and this is classed among the potato-growing sections.

There was no water at all in many small streams, and wells and springs that were never known to fail before have gone dry. Water for stock is a serious problem in many localities, and many fires have occurred as a result of the dry weather. A match dropped in a pasture is likely to cause a disastrous fire. The water supply of many towns has given out, and in some counties the situation is so severe that groundhogs, squirrels, and quail have been forced to come to the vicinity of farmhouses for water. In one section hundreds of snakes were seen crawling around in an apparently dazed condition, famishing for water.

Reports from several sections in the burley tobacco district state that about one-half of the tobacco has now been cut and the crop is much shorter than the lowest estimates had placed it.

Mr. J. W. Newman, commissioner of agriculture for the State of Kentucky, says:

> My crop reporters have sent in a good deal of scattered information about the effects of the drought in different parts of the State. Summarizing these, together with my personal observations: The drought has extended from the Mississippi to the eastern borders of Kentucky, gradually growing less severe as the mountains are approached. There has been an occasional streak throughout the State that has had local showers which have saved the crops more or less in the limited area. It appears that the lack of moisture has not done so much damage as the excessive heat. The pollen of the corn seems to have been rendered more or less infertile. Many of the apparent ears of corn are nothing but cobs, showing a lack of fertilization. Reports come to this office that many ears of corn have a dry rot that is going to injure very materially the partial crop that has been made. Stock has suffered for water but has not been bothered as much as usual by flies. The dry weather seems to have prevented the hatching of insects that depend on decaying vegetation as a means of producing life. Typhoid fever has been reported in many sections, attributed to the stagnant supply of water. Fires have been reported as being numerous as a result of the dry conditions of the pastures. The excessive heat has rendered work on the farm very difficult. Horses have been unable to do more than a half-day's work on many days, and day laborers have been unable to withstand the heat and do a full day's work.

The cool, dry weather which largely prevailed during the months of April and May and in early June was detrimental to the crops, the effect being to retard the germination of seed and the early growth and development of the plants.

Beginning with the excessive rains and floods of January and the extraordinary rains and the severer floods of March, the deficiency in rainfall during the crop-growing season, from April 1 to date, the unseasonably cool weather of April, May, and early June, and the excessive heat from the middle of June to date, September 13, have made 1913, so far, one of the most disastrous seasons in recent years.

## THE DROUGHT OF 1913 IN TENNESSEE.

By ROSCOE NUNN, Section Director.

Beginning about the middle of June, temperatures were almost steadily above normal for nearly three months, or until September 12, there being only 16 days during this time with mean temperature at Nashville normal or lower, and such breaks in the heat as came were of unusually short duration.

The afternoon temperatures especially were high, the records showing 69 days from June 1 to September 10, inclusive, with maximum temperatures 90° or above. This is the greatest number of such days on record at Nashville for the corresponding period, as only one other year, 1881 with 68 such days, approaches it in this respect.

The year 1901 had a very warm July, but the summer as a whole was not as warm as 1913, and the drought in 1901 was comparatively short.

For the summer as a whole, mean temperatures have been as follows for the hottest summers: In 1874, 81.6°; 1881, 81.0°; 1913, 79.8°. The present summer therefore has not been the hottest on record, nor does any month of the three, June, July, and August, show a higher mean maximum or mean minimum than any previous corresponding month. But 1913 is one of three hottest summers, considering the record in its various arrangements. For night temperatures, the summer of 1913 takes about the sixth place, considering the summer as a whole, for the average was highest in 1874, second highest in 1900, third in 1881, fourth in 1889, and fifth in 1901. For continued high-day temperatures, however, the summer of 1913 has not been surpassed, although the extreme record for no month was broken until September 3, when the record was a fraction of a degree higher than ever before registered for September. This hot spell has been especially characterized by its persistence, the periods of cloudiness or of falling temperature being few and brief. The percentage of bright sunshine was greater than in any previous summer since instrumental records of sunshine began.

The total rainfall for the three months, June, July, and August, is the lowest on record for Nashville; but the corresponding period of 1907 had almost as light, while 1881 and 1902 are the next driest, in order. The total rainfall for June, July, and August in the years mentioned was as follows: In 1913, 5.84 inches; 1907, 6.00 inches; 1881, 6.37 inches; 1902, 7.35 inches.

The drought of 1913 was pretty well broken at Nashville during the first half of July, but during the last half of July and all of August it was very persistent. For the three months there were only 17 days with measurable rainfall, while the other years of drought show from 20 to 33 such days. In this respect 1913 was quite different from 1907, next to 1913 the driest summer, which had 28 days with measurable rainfall.

### EFFECT UPON CROPS, ETC.

Notwithstanding the droughty conditions in the State, there were showers in various sections, and some localities suffered much less than others, the local character of the rainfall being frequently remarked upon, and some sections seemed not to suffer much from drought until about the middle of August. During the last half of August and the first 10 days of September the drought increased in severity and became quite general over the State.

The damage to corn was probably about 40 per cent, to early corn not so much, but to late planted 40 to 60